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Sustainable Supply Chain Network Design: A Review of Literature for 2011-2019

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ABSTRACT. *In the atmosphere of sustainable development and low carbon, the design of supply chain network closely related to logistics industry, is becoming more and more important. The traditional supply chain network no longer meets the need of social, economy and environment. After studying the literature from 2011 to 2019, many focused on green and sustainable supply chain network design under uncertain conditions. This paper intends to account for developments in the literature on supply chain management, and highlights both the challenges and opportunities, and more importantly, offers useful insights on the development in the future.*

KEYWORDS: *sustainable supply chain network design, society, economy, environment*

1. Background

Supply chain network design is one of the more complex strategic decision-making problems of supply chain. It needs to decide the number, location, capacity, type and other network parameter configuration problems of network facilities in the supply network, and then make the optimal planning for the long-term effective operation of the whole supply chain. Supply chain network design will have an impact on the operation cost, profit, risk resistance and other products of the supply chain. As a result, it is an important cornerstone of supply chain strategic decision-making.

With the acceleration of globalization and industrialization, environmental pollution, ecological damage and social problems have been widely concerned by countries all over the world [1] [2]. The continuous influences enforce enterprises to consider them along with economic performance to change the operation mode of the traditional supply chain network. A lot of studies turn to develop a new type of supply chain network, mainly including green supply chain network design (GSCND) and sustainable supply chain network design (SSCND), to decrease the damage to environment. Many scholars have studied this issue, and the number is

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still rising. The paper presents a thorough bibliometric and content analysis studies from 2011 until 2019.

The meaning of sustainable development is "to meet the current requirements without compromising the ability of future generations to meet their own needs" [3]. What's more, it considers triple bottom line concept including people, planet and profit [4]. However, Devika et al. considered there is a certain gap in the published researches in the supply chain network design [5]. The same shortage in these papers is that they all lack in the consideration of triple bottom lines of sustainability, simultaneously.

This paper is divided into four sections. The review analysis is detailed in Section 2. Section 3 discusses important findings over major decisions over SSCND. Finally, Section 5 presents the conclusion and the suggestions for future research in this paper.

2. Review analysis

Current study about SSCND has gained more and more attention among the scholars [6]. In the past several years, many researches present an integration perspective at the aspect of environment and economy. However, in the SSCND, the social indicators should be attached in the supply chain network closely [7]. When referring to the sustainability, all aspects in the triple bottom line (TBL) should be investigated in the studies, which create a necessary cooperation between human, profit, and the earth [8]. Although the number of the SSCND papers is increasing, the published papers mainly focus on greenness and cost benefit of networks. Only few surveyed papers stated that social aspects as well as economic and environmental aspects [1] [5] [9] [10] [11] [12] [13] [14]. In this concern, The SSCND models contains three types: social commitment, consumer issues and working conditions [15].

This paper analyses studies in the past 10 years, mainly about the social aspect in the SSCND. The results are as following in the Table 1.

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Table 1 Summary of SSCND literature from 2014 to 2019.

Research Work	Social aspects	Environmental aspects	Economic aspects	Uncertainty
You et al. [16]		√	√	√
Pinto-Varela et al. [17]		√	√	√
Pishvaee et al. [18]		√	√	√
Pishvaee et al. [19]	√		√	√
Pishvaee et al. [20]		√	√	√
Phuc et al. [21]			√	√
Yue et al. [9]	√	√	√	
Pishvaee et al. [22]	√	√		√
Devika et al. [5]	√	√	√	
Govindan et al. [1]	√	√	√	√
Mota et al. [10]	√	√	√	
Zhalechian et al. [11]	√	√	√	√
Talaei et al. [23]		√	√	√
Tsao et al. [24]	√	√		√
Soleimani et al. [25]	√	√	√	√
Feito-Cespon et al. [26]	√	√	√	√
Zahiri et al. [27]	√	√	√	
Arampantzi et al. [28]	√	√		
Babazadeh et al. [29]	√	√	√	√
Babazadeh et al. [30]	√	√	√	
Govindan et al. [31]	√	√	√	
Ghaderi et al. [32]	√	√		√
Rahimi et al. [33]	√	√		√
Fattahi et al. [34]	√	√	√	√
Sahebjamnia et al. [35]	√	√		
Mota et al. [36]	√	√		√
Allaoui et al. [37]	√	√		
Rahimi et al. [38]	√	√		√
Sherafati et al. [39]	√	√	√	√

2.1. Design of sustainable supply chain network

From Table 1, the past few years, economic factors have been studied the most. In recent years, there are more and more papers on social dimension, including development or balanced development, customer issues and work conditions. Many supply chain models consider social factors and try to increase opportunities of job in the designed network [5] [22] [28] [29] [35] [36] [37] [38]. The increasing regional is addressed by Fattahi and Govindan and Zahiri et al. studies the factor of balancing of regional development [34] [27]. Zhang et al. and Feito-Cespon et al. focus on customer satisfaction, which is second social target. What's more, by weighted balanced regional development, employment opportunities will also increase, and it has many advantages, covering the whole society, which is benefitable to some economic and social [24] [26] [39].

Through literature analysis, many documents integrate social impact as a factor or factors into the impact of economy or environment, and the ultimate objective function has only two aspects-- economy and environment. Devika et al. tried to minimize the cost and environmental impact [5]. Govindan et al. proposed a multi-

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objective optimization mode, aiming at to minimize the total cost and environmental impact of both SCND and order allocation problems [1]. Arampantzi and Minis considered all decisions of TBL in their model [28]. CO_2 emission costs, the investment and operational costs are all incorporated in the economic objective function. Soleimani, Govindan and Saghaf et al. proposed a closed loop supply chain design while they considered all three aspects of sustainability [25].

2.2. Under the uncertainty

Here are many sources of uncertainty in supply chain, such as customers' demand [40] [41] [42] [24] [38], production [39], transport cost [38] and so on, which directly affect decision-making. Without considering the uncertainty factors or ignoring the adverse consequences of uncertainty on the cost, operation and management in supply chain system, the optimized supply chain network structure can't adapt to the changes of actual demand, or the advantages of the designed supply chain network in the actual operation can't be reflected.

In many cases, if the uncertainty has not been handled properly, it would be negative on the whole supply chain network. It is obvious that supply chain modeling without considering uncertainty is unrealistic, and it is often emphasized that a model using deterministic optimization model, is needed to overcome the shortcomings [43].

Several ways have been suggested to consider uncertainties, including applying stochastic [11] [26] [32] [34] [36] [38], fuzzy [11] [18] [21] [23] [24] [25] [29] and robust logic [1] [23] [32].

It is found that more and more heuristic algorithms are applied to the design of supply chain network, such as genetic algorithm, particle swarm optimization, which is often improved according to the actual situation.

3. Results and Discussion

With the development of society, environmental problems have a positive impact to economy. Then, a lot of papers about supply chain network design occur in order to decrease the CO_2 emission and conserve resources. Recently, the sustainability is integrated to the supply chain network design, emphasizing on the coordination and unity of the society and environment and economy. A brief review of the related studies can be observed in Table 1. From Table 1, previous research objectives of SSCND all contain economic level, most studies environmental objective, while few papers dealt with social problems, because of the difficulty of modeling social impacts and environmental aspects. In sustainable development, employment issues, regional development, customer satisfaction, which are on behalf of social aspect. And a weighted balanced regional development in sustainable aspect has few studies in previous related researches.

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As shown in Table 1, most problems with uncertain parameters are modeled in fuzzy or random environment, but there are few literatures on robust optimization.

4. Conclusions and future research

In this section, it will summarize the previous literature analysis and make suggestions for the future development of supply chain.

In the SSCND, social factors are an aspect worthy of deep exploration and how to transform unmeasurable social problems into measurable problems is a key point and how to transform unmeasurable social problems into measurable problems is a key point.

Considering different types of parameter uncertainties is another gap in the future. Further research may attempt to build a model that takes into account other challenges.

Most researchers used carbon dioxide emissions as an environmental impact on economic development. Taking carbon dioxide emission as an index, the impact of production of manufacturing, distribution center and transportation products on the environment is quantified. More environmental factors, for example, water resource, are waiting to be found, making supply chain decision-making optimal.

Compared with the forward logistics supply chain, the design of closed-loop supply chain and reverse logistics supply chain is far more complex, but more practical.

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References

[1] K. Govindan, A. Jafarian and V. Nourbakhsh (2015). Bi-objective integrating sustainable order allocation and sustainable supply chain network strategic design with stochastic demand using a novel robust hybrid multi-objective metaheuristic. Computers & Operations Research, vol.62, p.112-130.

[2] H. Badri, S.M.T.F. Ghomi and T.H. Hejazi (2017). A two-stage stochastic programming approach for value-based closed-loop supply chain network design. Transportation Research Part E-Logistics and Transportation Review, vol.105, p.1-17.

ISSN 2616-5783 Vol. 2, Issue 6: 1-8, DOI: 10.25236/AJHSS.2019.020601

[3] G. Brundtland (1987). The Brundtland Report. World commission on environment and development.
[4] J. Elkington and I. Rowlands (1999). Cannibals with forks: the triple bottom line of 21stcentury business. Alternatives Journal, p.25- 42.
[5] K. Devika, A. Jafarian and V. Nourbakhsh (2014). Designing a sustainable closed-loop supply chain network based on triple bottom line approach: a comparison of metaheuristics hybridization techniques. European Journal of Operation Research, vol.235, no.3, p.594-615.
[6] K. Govindan, H. Soleimani and D. Kannan (2015b). Reverse logistics and closed-loop supply chain: a comprehensive review to explore the future. European Journal of Operational Research, vol.240, no.3, p.603-626.
[7] L. White and G.J Lee (2009). Operational research and sustainable development: tackling the social dimension. European Journal of Operational Research, vol.193, no.3, pp. 683-692.
[8] P.R., Kleindorfer, K. Singhal and L.N. Van Wassenhove (2005). Sustainable operations management. Production and Operations Management, vol.14, no.4, p.482–492.
[9] D. Yue, M.A. Kim and F. You (2013). Design of sustainable product systems and supply chains with life cycle optimization based on functional unit: general modeling framework, mixed-integer nonlinear programming algorithms and case study on hydrocarbon biofuels. ACS Sustaunable Chemistry & Enginering, vol.1, no.8, p.1003-1014.
[10] B. Mota, M.I. Gomes, A. Carvalho and A.P.B. Povoa (2015). Towards supply chain sustainability: economic, environmental and social design and planning. Journal of Cleaner Production, vol.105, p.14-27.
[11] M. Zhalechian, R. Tavakkoli-Moghaddam, B. Zahiri and M. Mohammadi (2016). Sustainable design of a closed-loop location-routing-inventory supply chain network under mixed uncertainty. Transportation Research Part E-Logistics and Transportation Review, vol.89, p.182-214.
[12] H. Soleimani, K. Govindan, H. Saghafi and H. Jafari (2017). Fuzzy multi-objective sustainable and green closed-loop supply chain network design. Computers & Industrial Engineering, vol.109, p.191–203.
[13] B. Zahiri, J. Zhuang and M. Mohammadi (2017). Toward an integrated sustainable-resilient supply chain: a pharmaceutical case study. Transportation Research Part E-Logistics and Transportation Review, vol.103, p.109-142.
[14] M. Sherafati, M. Bashiri, R. Tavakkoli-Moghaddam and M.S. Pishvaee (2019). Supply chain network design considering sustainable development paradigm: A case study in cable industry. Journal of Cleaner Production, vol.234, p.366-380.
[15] M. Eskandarpour, P. Dejax, J. Miemczyk and O. Peton (2015). Sustainable supply chain network design: an optimization-oriented review. Omega-International Journal of Management Science, vol.54, p.11-32.
[16] F. You and B. Wang (2011). Life cycle optimization of biomass-to-liquid supply chains with distributed centralized processing networks. Industrial & Engineering Chemistry Research, vol.50, no.17, p.10102-10127.
[17] T. Pinto-Varela, A.P.F.D. Barbosa-Povoa and A.Q. Novais (2011). Bi-objective optimization approach to the design and planning of supply chains: economic

ISSN 2616-5783 Vol. 2, Issue 6: 1-8, DOI: 10.25236/AJHSS.2019.020601

versus environmental performances. Computers & Chemical Engineering, vol.35, no.8, p.1454-1468.

[18] M.S. Pishvaee and J. Razmi (2012). Environmental supply chain network design using multi-objective fuzzy mathematical programming. Applied Mathematical Model, vol.36. no.8, p.3433-3446.

[19] M.S. Pishvaee and J. Razmi and S.A. Torabi (2012a). Robust possibilistic programming for socially responsible supply chain network design: a new approach. Fuzzy Sets Systems, vol.206, p.1-20.

[20] M.S. Pishvaee, S.A. Torabi and J. Razmi (2012b). Credibility-based fuzzy mathematical programming model for green logistics design under uncertainty. Computers & Industrial Engineering, vol.62, no.2, p.624-632.

[21] P.N.K. Phuc, F.Y. Vincent and S.Y (2013). Chou. Optimizing the fuzzy closed-loop supply chain for electrical and electronic equipments. International Journal of Fuzzy Systems, vol.15, no.1, p.9-21.

[22] M. Pishvaee, J. Razmi and S. Torabi (2014). An accelerated benders decomposition algorithm for sustainable supply chain network design under uncertainty: a case study of medical needle and syringe supply chain. Transportation Research Part E-Logistics and Transportation Review, vol.67, p.14-38.

[23] M. Talaei, B.F. Moghaddam, M.S. Pishvaee, A. Bozorgi-Amiri and S. Gholamnejad (2016). A robust fuzzy optimization model for carbon-efficient closed-loop supply chain network design problem: a numerical illustration in electronics industry. Journal of Cleaner Production, vol.113, p.662-673.

[24] Y.C. Tsao, Q. Zhang and T.H. Chen (2016). Multi-item distribution network design problems under volume discount on transportation cost. International Journal of Production Research, vol.54, no.2, p.426-443.

[25] H. Soleimani, K. Govindan, H. Saghafi and H. Jafari (2017). Fuzzy multi-objective sustainable and green closed-loop supply chain network design. Computers & Industrial Engineering, vol.109, p.191-203.

[26] M. Feito-Cespon, W. Sarache, F. Piedra-Jimenez and R. Cespon-Castro (2017). Redesign of a sustainable reverse supply chain under uncertainty: a case study. Journal of Cleaner Production, vol.151, p.206-217.

[27] B. Zahiri, J. Zhuang, M. Mohammadi (2017). Toward an integrated sustainable-resilient supply chain: a pharmaceutical case study. Transportation Research Part E-Logistics and Transportation Review, vol.103, p.109-142.

[28] C. Arampantzi and I. Minis (2017). A new model for designing sustainable supply chain networks and its application to a global manufacturer. Journal of Cleaner Production, vol, 156, p.276-292.

[29] R. Babazadeh, J. Razmi, M.S. Pishvaee and M. Rabbani (2017a). A sustainable second-generation biodiesel supply chain network design problem under risk. Omega-international Journal of Management Science, vol.66, p.258-277.

[30] R. Babazadeh, J. Razmi, M. Rabbani and M.S. Pishvaee (2017b). An integrated data envelopment analysis-mathematical programming approach to strategic biodiesel supply chain network design problem. Journal of Cleaner Production, vol.147, p.694-707.

ISSN 2616-5783 Vol. 2, Issue 6: 1-8, DOI: 10.25236/AJHSS.2019.020601

[31] K. Govindan, A. Jafarian and V. Nourbakhsh (2018). Designing a sustainable supply chain network integrated with vehicle routing: a comparison of hybrid swarm intelligence metaheuristics. Computer & Operations Research, vol.110, p.220-235.
[32] H. Ghaderi, A. Moini and M.S. Pishvaee (2018). A multi-objective robust possibilistic programming approach to sustainable switchgrass-based bioethanol supply chain network design. Journal of Cleaner Production, vol.179, p.368-406.
[33] M. Rahimi and V. Ghezavati (2018). Sustainable multi-period reverse logistics network design and planning under uncertainty utilizing conditional value at risk (cvar) for recycling construction and demolition waste. Journal of Cleaner Production, vol.172, p.1567-1581.
[34] M. Fattahi and K. Govindan (2018). A multi-stage stochastic program for the sustainable design of biofuel supply chain networks under biomass supply uncertainty and disruption risk: a real-life case study. Transportation Research Part E-Logistics and Transportation Review, vol.118, p.534-567.
[35] N. Sahebjamnia, A.M.F. Fard and M. Hajiaghaei-Keshteli (2018). Sustainable tire closed-loop supply chain network design: hybrid metaheuristic algorithms for largescale networks. Journal of Cleaner Production, vol.196, p.273-296.
[36] B. Mota, M.I. Gomes, A. Carvalho and A.P. Barbosa-Povoa (2018). Sustainable supply chains: an integrated modeling approach under uncertainty. Omega-international Journal of Management Science, vol.77, p.32-57.
[37] H. Allaoui, Y. Guo, A. Choudhary and J. Bloemhof (2018). Sustainable agro-food supply chain design using two-stage hybrid multi-objective decision-making approach. Computer & Operations Research, vol.89, p.369-384.
[38] M. Rahimi, V. Ghezavati and F. Asadi (2019). A stochastic risk-averse sustainable supply chain network design problem with quantity discount considering multiple sources of uncertainty. Computers & Industrial Engineering, vol.130, p.430-449.
[39] M. Sherafati, M. Bashiri, R. Tavakkoli-Moghaddam and M.S. Pishvaee (2019). Supply chain network design considering sustainable development paradigm: A case study in cable industry. Journal of Cleaner Production, vol.234, p.366-380.
[40] C.L. Chen, T.W. Yuan and W.C. Lee (2007). Multi-criteria fuzzy optimization for locating warehouses and distribution centers in a supply chain network. Journal of the Chinese Institute of Chemical Engineers, vol.38, no.5, p.393–407.
[41] D. Petrovic, Y. Xie, K. Burnham and R. Petrovic (2008). Coordinated control of distribution supply chains in the presence of fuzzy customer demand. European Journal of Operational Research, vol.185, no.1, p.146–158.
[42] T. Efendigil, S. Önüt and C. Kahraman (2009). A decision support system for demand forecasting with artificial neural networks and neuro-fuzzy models: A comparative analysis. Expert Systems with Applications, vol.36, no.3, p.6697–6707.
[43] H. Yu and W.D. Solvang (2018). Incorporating flexible capacity in the planning of a multi-product multi-echelon sustainable reverse logistics network under uncertainty. Journal of Cleaner Production, vol, 198, p.285-303.